THE INSTITUTE OF PHYSICS
47 BELGRAVE SQUARE, LONDON, S.W.1.

# BULLETIN

No. 55 JULY, 1954

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THE INSTITUTE OF PHYSICS

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## NOTES ON THE EARLY HISTORY AND THE GROWTH OF THE INSTITUTE

Most people are nowadays well aware of the great influence of physical science upon their everyday lives. Physicists realize that this influence has increased since the last war but perhaps even they do not always appreciate just how rapid the growth has been. Some measure of it in the last few years may be provided by the growth, in numbers and influence, of The Institute of Physics.

During the first World War the idea of forming a professional body for physicists was discussed informally by several physicists, including Sir Ernest Rutherford, Dr. W. H. Eccles and Mr. W. B. Duddell (who died in 1917). A specific proposal was put forward by the late Major C. E. S. Phillips at a meeting of the Council of the Physical Society of London on November 23, 1917. Following discussions with representatives of other interested societies the Institute was eventually founded in 1918 and in 1920 was incorporated under the Companies Act. Of the seventeen men whose names were subscribed to the original request for incorporation there are but four survivors : Dr. E. H. Rayner, Dr. W. H. Eccles, Instr.-Com. T. Y. Baker and Mr. T. Smith.

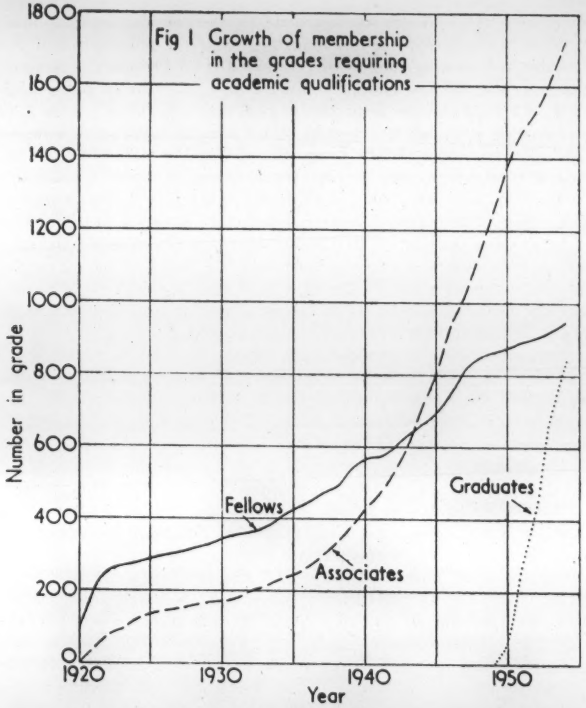
The constitution of the Institute was broadly similar to that of the present day. There were two corporate grades of membership, Fellow and Associate, and a grade of Ordinary Member : no provision was made for Students.

In April, 1920, a first list of Fellows was published, a list which now appears as an exceptionally distinguished collection of names. The first President was Sir Richard Glazebrook and there were 100 other Fellows, together with Sir Joseph J. Thomson as the first Honorary Fellow. No less than 35 of the 102 members were Fellows of the Royal Society and at least 11 of the remainder have subsequently been elected to that body. These first Fellows included E. N. da C. Andrade, C. V. Boys, Sir William Bragg, W. L. (now Sir Lawrence) Bragg, C. V. Drysdale, Major K. Edgcumbe (now the Earl of Mount Edgcumbe—and the Institute's landlord), T. R. (now Sir Thomas) Merton, Sir Charles Parsons, C. C. (later Sir Clifford) Paterson, R. W. Paul, Lord Rayleigh, F. E. (now Sir Frank) Smith, H. T.

(now Sir Henry) Tizard, F. Twyman and A. M. Tyndall. From a distance of almost thirty-five years it seems as though the Institute was an army of many generals and few privates, but although a lack of balance would be expected at the inauguration of such a body, it should be remembered that physicists were then very few. The absence of privates was not because of a refusal to enlist. On April 27, 1921, at the formal inaugural meeting, J. J. Thomson gave an address in which he spoke of the changed position of the physicist during his lifetime. Referring to the total potential membership of the Institute, he said, " already, in the first year of its existence, some 300 Members have joined. I should, if I were to make a rough guess, and if I were to include among the potential members of this Institute those science masters who have done research and who are interested in research—I should think that probably there would be a number of somewhere about 800 to 1000 men available." At this meeting the Rt. Hon. A. J. Balfour, Lord President of the Council, also spoke.

There are now (May, 1954) 3,659 members of the three grades—Fellow, Associate and Graduate—which imply professional status ; the growth of membership of these grades is shown in Fig. 1. In addition, there are about 600 Students and 450 Subscribers. Over the years the requirements for membership have changed, usually in the direction of increased rigour. The minimum period of experience originally required for Fellowship was five years and for Associateship one year. Now the minimum periods are respectively seven or ten, depending upon the nature of the experience, and three or five depending on the class of degree. Even more important is the higher standard imposed for the quality of experience. The grade of Graduate was established only in the Autumn of 1949 and, while there are many in this grade who may never have the type of experience needed for transfer to Associateship, most Graduates would have been eligible to become Associates under the conditions applying in pre-war days. There has been a slight relaxation in the academic requirements for Associateship but it is beyond doubt that election to either Fellowship or Associateship is much more stringently an indication of competence, with an emphasis upon experience, than in earlier days. The fact that the Institute's diplomas are indicative of professional competence recognized by senior scientific colleagues is widely appreciated by those concerned with appointments and promotions.

In its earliest days the Institute was without financial resources and a guarantee fund was launched to cover the inaugural period. The income in the first year, excluding that from the guarantee fund, was a little over £600. At that time the Institute did not have its own office and the secretarial work was done by the late Frederick Spiers (a Founder Fellow) who was at that time secretary of the



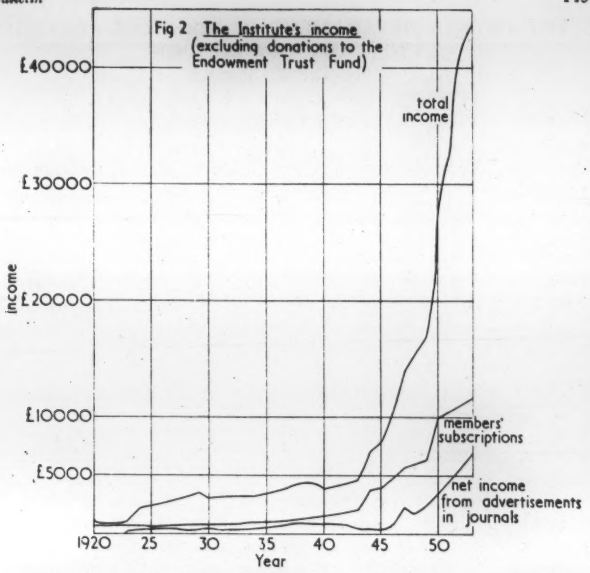

Faraday Society. The cost of salaries and office expenses was at the rate of £550 a year. The ordinary income of the Institute grew only gradually to about £1000 a year but the total income increased suddenly with the establishment in 1923 of the *Journal of Scientific Instruments*. Steps to launch such a journal had been taken in 1921 when a deputation from the Board had met representatives of the Department of Scientific and Industrial Research ; a grant from that Department helped to defray the cost of a Preliminary Number of the journal. For the first few years the journal was edited at the National Physical Laboratory, although the Institute was responsible both financially and editorially. The Institute paid an annual sum of £650 (shortly reduced to £450) to the Laboratory for the work carried out. The Board's Annual

Report for 1923 contains the comment, "Unfortunately, promises made to contribute articles did not mature in time for publication in July and the first number had to be postponed until October." Authors' characteristics do not change ! In the first full year of publication, 1924, the total income from the journal was £1,495 of which £268 was income from advertisements. This may be contrasted with last year's income of £31,620 from publications, including £7,018 net income from advertisements after the payment of agents' commission.

In 1927, after the death of Frederick Spiers, the Institute took its own office at Lowther Gardens, Exhibition Road, now the rooms of the Physical Society. Mr. Thomas Martin was appointed Secretary and an arrangement was reached whereby the Institute's office carried out also the greater part of the secretarial work of the Physical Society and the Optical Society. For the next twelve years the Institute's income included contributions for this work and, of course, its expenditure on salaries was correspondingly increased. Mr. Martin resigned in 1929, on his appointment as General Secretary of the Royal Institution, to be succeeded by Dr. J. J. Hedges who was in turn succeeded by Dr. H. R. Lang in 1931. The post of Assistant Secretary (later Deputy Secretary) was created in 1945.

From 1931 to the beginning of the War was a period of slow but steady growth. The year 1932 saw the founding of the first home Branch, in Manchester (Branches already existed in Australia and India), with Professor W. L. Bragg as Chairman and Dr. H. Lowery as first Honorary Secretary. The Midland Branch was established in 1935 and London and Home Counties in 1936 (the indefatigable Dr. Lowery, having now moved to London, being first Honorary Secretary). With the outbreak of war the Institute's secretariat moved to the University of Reading, through the good offices of the Honorary Secretary, the late Professor J. A. Crowther. Under the inevitably difficult conditions of limited space and reduced staff, mainly newly-recruited, it is surprising that the Institute was able to keep pace with the greatly increased need by members for technical and professional services. Yet this was an important period of growth in membership and in the range of activities. The first of the Groups (Industrial Radiology—now Non-Destructive Testing) was established in 1941 and did much valuable work related to the war. In 1942 the Electronics Group was founded and by the end of the year had 200 members, while the X-ray Analysis Group was established in 1943. Two new Branches—Scottish and South Wales—were formed in 1944.

At the end of the war the Institute's office was moved to a small suite of rooms owned by and adjacent to the Royal Institution and steps were taken to find a suitable post-war home for the Institute, fitted to its needs and appropriate to its much increased




membership and enhanced reputation. The move was made to Belgrave Square in the last week of 1946. From that time to the present there has been great and sustained expansion in all sides of the work, with particular emphasis upon publications, education and the organization of specialist conferences. Some idea of the growth can be obtained from Fig. 2 which shows the total annual income of the Institute, excluding contributions to the somewhat mis-named Endowment Trust Fund and donations to the Benevolent Fund.

The full-time staff of the Institute, including house-staff, now numbers thirty-three, about half being concerned with the production, sale and distribution of publications.

A full-length history of the Institute would be worth the writing, particularly if it dealt adequately with some of the colourful personalities intimately connected with that history. Younger physicists may find these notes of some interest and may realize how different were the circumstances of physicists thirty or forty years ago. One may not unreasonably believe that the greater utilization of physics to-day owes much to the enthusiasts who played a big part in the founding and nurture of our Institute.

N. CLARKE.

## THE PHYSICS DEPARTMENT OF BIRKBECK COLLEGE (UNIVERSITY OF LONDON)

By R. FURTH, D.Phil., F.R.S.E., F.Inst.P.
(*Reader in Theoretical Physics, Birkbeck College.*)

Birkbeck College was founded in 1823 as the "London Mechanics' Institution" for the original purpose of supplying education to craftsmen and small employers "in the principles of the arts they practised and in the various branches of science and useful knowledge," and its first president was Dr. George Birkbeck who was mainly responsible for this new venture. But soon its students came from many other professions and classes. In 1858 the University of London was given the right to confer academic degrees to external candidates; from this time on the principal aim of the Institution was to provide part-time academic teaching for workers from all walks of life in order to enable them to obtain a University degree. In 1866 it assumed the name "The Birkbeck Literary and Scientific Institution" and in 1907 the name "Birkbeck College" was finally adopted.

In 1920 Birkbeck College was admitted "as a School of the University of London in the Faculties of Arts and Science for evening and part-time students," and it was granted a Royal Charter in 1926. Since then the status of its students has been the same as that of all other "internal" students of the various Colleges and Schools belonging to London University; they sit for the same common examinations as the full-time students, and the degrees conferred upon them are the internal degrees of the University. According to the Charter, however, the undergraduates must be engaged during the day in full-time paid employment and must be unable to devote more than their leisure hours to study. This makes Birkbeck College a unique Institution in the Universities of the United Kingdom, if not in the whole world.

The College has suffered a great deal in the past from insufficient accommodation, especially since the greater part of its buildings in the City of London had been destroyed during the war. It is now housed in Malet Street, W.C.1, next to the Senate House of the University in a new and modern building (Fig. 1) which was occupied in 1951. But by the time the building was completed the needs for teaching and research had grown so much that it was already too small. Some of its research laboratories are therefore still accommodated in a number of adapted houses in the vicinity of the main building, and most of the lectures in the Faculty of Arts have to be given in class-rooms in adjoining Institutes of the University.

The Physics Department occupies part of the ground floor and the basement of the main building; in addition accommodation is provided at 21/22/32 Torrington Square for teaching and research in Crystallography. The accommodation in the main building

*Fig. 1. Birkbeck College.*

*Fig. 2. One of the large teaching laboratories.*

comprises two lecture theatres with seating capacity for 120 and 70 students respectively (the smaller one being shared with the Chemistry Department), two large (Fig. 2) and two smaller (optical) teaching laboratories, three large and six small research laboratories, a photographic laboratory, staff rooms, offices, etc. The well equipped College workshop is also situated within the precincts of the Physics Department.

The President of the College is the Rt. Hon. Lord Justice Denning, P.C., and its Master is Dr. J. F. Lockwood, his predecessor Dr. H. Gordon Jackson having died in an accident shortly before the completion of the new building. The Head of the Physics Department is Professor J. D. Bernal, F.R.S. ; its academic staff consists of two readers, nine lecturers and two assistant lecturers who are aided by a number of demonstrators and tutors. There is further an efficient administrative and technical staff.

Teaching to undergraduates is done by way of lecture courses, practical laboratory courses and tutorial instruction. A one-year course is provided for intermediate science students, a two-year general B.Sc. course, a four-year (instead of the usual three-year) special (honours) B.Sc. course, and an ancillary two-year course for students of other science branches, mainly chemistry. The present numbers of students in the Physics Department are : Intermediate Science 41,

General B.Sc. 37, Special B.Sc. 77, Ancillary 43, total 198. The lectures are all given in the evenings, between 6 and 9.30 p.m., and most of the students also do their laboratory work during this period, but the laboratories are open on most afternoons and on Saturday mornings for students who are given some time off by their employers.

The fact that all the teaching has to be concentrated in the evenings makes it necessary to restrict somewhat the total number of lecturing hours for the various courses in comparison with the time devoted to the same courses at the day Colleges of the University. On the other hand, as most of the physics students are either teachers or employees of technical firms, they know rather more about certain aspects of their subject than the average student of physics, and it is therefore possible to restrict the courses more or less to the systematic teaching of the fundamental principles of experimental and theoretical physics, deliberately leaving a certain amount of the study of details to the reading of textbooks ; but the students are helped by individual tutorial instruction if they so wish. In particular the first-year special B.Sc. course is designed as an introductory course, comprising an introduction to experimental physics with special emphasis on the history of physics, and an introduction to theoretical physics, in order to make the students acquainted with the main principles and methods of this branch of physics right at the beginning of their studies. The course also contains an introduction to the principles and methods of observation and a set of specially designed laboratory experiments of a fundamental nature. The fourth year of the special physics course, which is taken by those students who have passed part I of the final B.Sc. examination is restricted to one or two subjects only, in which active research is being done in the Department. Detailed lecture courses are given on a higher level on these subjects in addition to a course on fundamental principles of physics, and the students are also engaged in laboratory work of a semi-research character.

Part- and full-time post-graduate students are admitted to Birkbeck College to study for the higher internal degrees of the University of London. Physicists can work for the M.Sc. in physics and crystallography and for the Ph.D. in the Faculty of Science. No formal M.Sc. courses in physics are given but a two-year M.Sc. course in crystallography is provided jointly by Birkbeck College and University College, three of the lecturers on the staff of the Physics Department being exclusively engaged in the teaching of crystallography and research in this field ; 20 students are attending the course at present. Informal post-graduate courses are, however, frequently given by members of the staff on topics within their domain of research, and these are attended by research students and also by members of the staff of other Colleges and Institutions.

The bulk of the post-graduate students are working for the Ph.D. and M.Sc. degrees on the basis of original research work which is directed and supervised by members of the staff. There are at present 25 Ph.D. students and 18 M.Sc. students of whom about one-third are working full-time and two-thirds part-time. In general a post-graduate student who wishes to do full-time research work will have to secure a maintenance research grant of some kind. In the immediate post-war period such grants were fairly plentifully provided by the education authorities, the Government, and various other Funds. Recent economy measures have reduced these grants severely and as a result research work in the Physics Department has been hampered by lack of a sufficient number of full-time research students. There is no lack of part-time research students, but experience has shown that the great strain of a full-time day occupation and research work in the evenings and over the week-ends proves to be too much for many of them ; besides the rate of progress of their work is inevitably slow, and this tends to retard the progress of the research programme as a whole. Nevertheless, it could not have been carried out at all without the collaboration of the research students.

The research laboratories are partly situated in the main building and partly at Torrington Square, and the work is carried out in a number of more or less independent sections within each of which a team of research workers is engaged in a specific research programme under the direction of a senior member of the staff. A very brief outline of the research problems of these groups will now be given.*

In the Electronics Section which is directed by Dr. W. Ehrenberg work is mainly done on the effects of electron bombardment on dielectrics and semiconductors, in particular on the penetration of electrons into fluorescent crystals and the so-called " electron voltaic effect." This section is also engaged in electron optical studies under the supervision of Dr. J. C. E. Jennings and carries out experimental work on high resolution electron spectroscopy and the aberrations of electron lenses, and theoretical computing work connected with these problems. In addition research on the optical focusing of X-rays and the development of reflecting X-ray cameras and fine focus X-ray tubes is done in the crystallographic laboratory at Torrington Square by A. Franks. There are altogether ten scientists working in this group.

The " Theoretical Physics Section " under the author of this article is in fact, apart from theoretical research, also engaged in some experimental investigations, closely related to the theoretical research

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*The author wishes to thank his colleagues for their help in preparing this account of the work of the Physics Department.

programme. The main part of the latter is devoted to the study of stochastic processes and fluctuation phenomena in connection with which experiments are done on radioactive fluctuations. Further theoretical research is carried out on the statistical theory of the solid and liquid state ; connected with this is experimental work on diffusion in liquids and on the scattering of light in liquids and solid crystals, the latter being carried out by Dr. S. P. F. Humphreys-Owen. The

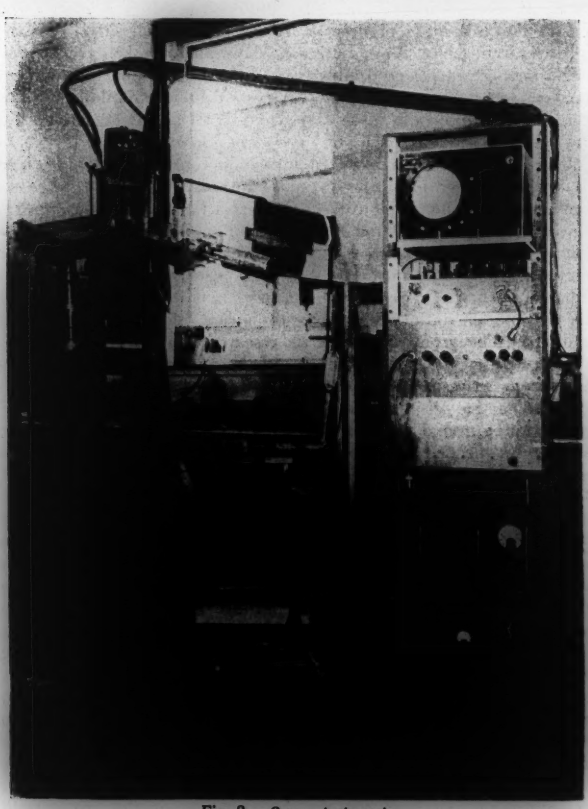

*Fig. 3. β-ray spectroscopy.*

development of certain auxiliary devices, namely of a photo-electric " Fourier transformer " and a photo-electric scanning microphotometer also form part of the research programme of this section. Finally mention may be made of a theoretical and experimental investigation into the mechanism of lubrication. The group consists at present of eight research workers.

The Cosmic Ray Section, which was until recently directed by Dr. E. P. George, owes its origin to Professor P. M. S. Blackett, who was Professor Bernal's predecessor in the chair of physics. It is the only research group whose activities show an unbroken record and whose members persevered under very difficult conditions in the basement of the half destroyed old College at Breams Buildings. The work of the section is now supervised by Dr. P. T. Trent and Dr. E. G. Michaelis partly in a research laboratory in the main College building and partly in two underground laboratories at Holborn Underground Station and the disused British Museum Station and another laboratory at the top of the Senate House tower. The main field of studies is the behaviour of $\mu$-mesons, and work is done on the determination of their momentum spectrum and on their scattering by lead by means of Wilson cloud chambers, on the origin of pairs of penetrating particles by means of counter telescopes, and on the lifetime of stationary mesons by means of liquid scintillation counters. The group comprises six research workers.

The work of the Nuclear Physics Section under Mr. R. E. Siday is devoted to $\beta$-ray spectroscopy, i.e. the measurement of spectral lines in $\beta$-radioactive disintegrations. The two main problems of the research programme are to achieve high resolution and high absolute accuracy in the determination of energy levels. For the first type of problem a spectrometer with a " magnetic prism " has been developed (Fig. 3) with a resolution of about 1,500 and work is being done to improve its performance. For the second type of problem a " magnetic lens " spectrometer using image rotation has been constructed with a precision better than 1 in 10,000 ; at present a much larger spectrometer is being made which, it is hoped, will have a considerably higher accuracy. The group consists of five research workers.

In addition to these main sections two smaller teams are working in research laboratories in the main building. One, under the supervision of Dr. N. E. Cusack consists of three research workers who are engaged in the technical development of diffusion and expansion cloud chambers and the investigation of the scattering of electrons and positrons in gases by cloud chamber methods. (Fig. 4). The other team, consisting of Mr. D. O. Sproule and one research student uses ultrasonic methods for the investigation of the stress-strain

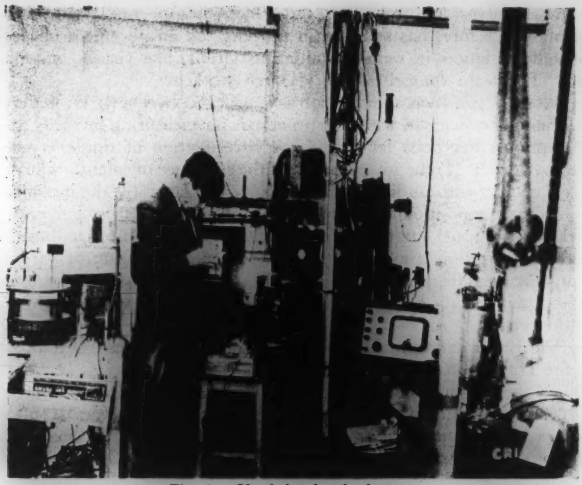

*Fig. 4. Cloud chamber development.*

relationship in solids above the elastic limit in time periods of less than one microsecond, and for the measurement of elastic constants of anisotropic media.

The research work in the field of crystallography is directed by Professor Bernal. The research laboratories at Torrington Square, in which this work is carried out, are well equipped for this purpose and have at their disposal a separate workshop in which most of the apparatus is made. The programme is divided between three sections, the " organic," the " inorganic " and the " computer " sections.

The Organic and Biomolecular Section, which is supervised by Dr. C. H. Carlisle, concentrates on four main topics, namely : (1) the X-ray study of very large molecules, such as plant viruses, with molecular weights of six million and more ; (2) the structure determination of protein molecules with molecular weights in the range of 10,000 to 40,000 such as ribonuclease, lysozyme, etc., and the examination of wheat proteins and their degradation products ; (3) the detailed study of smaller complex molecules of molecular weights between 200 and 600, such as polypeptides, sterols, terpenes and biologically active compounds, by means of X-ray diffraction, with the eventual aim of determining the structure of substances of completely unknown composition ; (4) the development of special

X-ray cameras and tubes by the Electronics Section, which was mentioned before, has as its main purpose the measurement of large periodic distances in semi-crystalline materials, like viruses, muscles, etc. The team comprises nine research workers.

Work in the Inorganic Section is supervised by Dr. J. W. Jeffery. It is mainly concerned with : (1) methods for measuring intensity and absorption corrections for the X-ray investigation of single crystals and powders ; (2) the investigation of the structure of calcium silicates in connection with studies on the physics of cement ; (3) the investigation of the composition and the properties of " fly ash " from pulverized fuel furnaces ; (4) studies of some fundamental aspects of combustion and carbonization ; and (5) the structure determination of various inorganic crystals, particularly hydrates. Special apparatus for these investigations is also being developed. There are eight research workers in this section.

The Electronic Computer Section has its laboratories in an annex to the Torrington Square building. It is directed by Dr. A. D. Booth who is also responsible for the design and development of a new type of computer which was constructed in that laboratory. Its main feature is its comparative smallness and simplicity and its " magnetic memory " which stores the data and operational instructions for carrying out a specific calculation in the shape of magnetic pulses on the surface of a steel cylinder. It started operating in 1952. The original purpose of the computer project was to facilitate the evaluation of X-ray diagrams by means of direct Fourier synthesis with the object of determining complicated crystal structures. Apart from these problems the present research programme also includes the solution of various problems in potential theory and quantum mechanics, the development of mathematical techniques for the solution of high order systems of linear equations and the improvement of components for digital calculators. The group consists of eleven research workers.

Clearly research activities of this extent and scope could not be pursued within the College without a great deal of outside help in the form of loan of instruments and grants for the purchase of apparatus, and in the form of research fellowships, assistantships and studentships. Grateful acknowledgement is due to the following Institutions : The Central Research Fund of the University of London, the Royal Society, the Nuffield Foundation, the Department of Scientific and Industrial Research, the Ministry of Supply, the British Electricity Authority, the National Coal Board, Imperial Chemical Industries Ltd., the British Flour Millers' Research Association, the British Rubber Manufacturers' Research Association, the British Rayon Research Association, the Research and Development Corporation, and the British Tabulating Machine Company.

# APPLIED PHYSICS IN THE GRADUATESHIP EXAMINATION*

By A. E. De BARR, B.Sc., F.Inst.P.
(*Head of Spinning Department, British Cotton Industry Research Association, Manchester ; Examiner in the applied physics options of the Institute's Graduateship Examination*)

The Institute's Graduateship Examination, as a new external examination free from the difficulties of co-ordination between different centres, offers an excellent opportunity to depart from the conventional type of examination question in favour of questions which provide a better test of the candidate's ability to make use of his knowledge in connection with the sort of problem he is liable to have to tackle in his employment. This is particularly true of the applied physics papers which are often closely linked with the candidate's day-to-day duties and which cover aspects of physics with which he might be expected to be reasonably familiar on a broader basis than that usually associated with examinations. Since the type of question which is most suitable for this sort of examination and candidate, and which is referred to in more detail later, seems to be somewhat different from that to which candidates and teachers are accustomed, there may at first be some difficulty in preparing candidates for this examination. Nevertheless I am encouraged by teachers' comments on the first two Graduateship examinations and by their criticisms of their own teaching methods, to feel that my present approach is correct and that it may encourage the development of more appropriate teaching methods.

Despite many assertions that there is no such thing as applied physics, I am quite clear what I mean by the term. It is the sort of physics by which I (and many others) manage to earn a living ! It differs considerably from the sort of physics described in most undergraduate text books, and also from that taught in many universities and technical colleges. This is not to suggest, of course, that it is fundamentally different from any other sort of physics, but its problems are presented in ways which are often very different from those to which the average student is accustomed.

The essential differences to which I refer are :—Firstly, in practice the full details of a problem are rarely stated explicitly. There are always other factors to consider. For instance the student may know many ways of distinguishing mild steel and carbon steel—magnetic methods, hardness, elasticity, etc., but if the object is to sort out rapidly many thousands of objects made in these materials, the most important considerations are not usually those stressed most in text-books.

* Based on a talk given on April 12, 1954, at a Discussion on National Certificates in Applied Physics held at the Institute's House.

Questions of speed, feasibility of application, and convenience supervene. Secondly, where a numerical answer is required, the accuracy is required to be just sufficient for the purpose.

The physicist in industry is required to view a problem in relation to all its surroundings, to exercise his judgment as to the relevance or otherwise of the factors presented to him, to apply to the solution of the problem such knowledge of physical phenomena as he possesses, and to produce an answer which is adequate. It is this sort of approach to the subject which, in my opinion, it is the function of the applied physics papers of the Graduateship examination to test.

I do not think the present syllabuses are perfect. I think that modifications, ranging from minor alteration to complete revision, are required in all. But, with perhaps one exception, they all cover the application of a branch of physics to some practical end. In all cases a thorough grasp of the fundamental physics of the subject, e.g. vibrating systems, wave motion, etc., in acoustics, or of the relations between X-radiation and atomic and crystal structures in X-rays, is, of course, essential. And this treatment should be as wide as possible. Thus, as an example, although the electronics syllabus is primarily concerned with the behaviour, under various conditions, of electrons in or associated with thermionic valves, a knowledge of the properties of the electron and of electronic conduction generally is equally important. Also important in all these syllabuses is the relation between the properties of immediate interest and the constitution or structure of the materials concerned, e.g. thermionic emission, and photoelectric properties, or acoustic absorption.

Then, certain physical principles occurring in these subjects should be understood first generally, then with reference to the particular application. Such concepts are impedance (in electronics, acoustics, temperature measurement, high vacuum technology), resonance (electronics, acoustics), and, in particular, feed-back. So many students (and others) regard feed-back as something peculiar to thermionic valve circuits. They do not appreciate that this is only one application and that the special properties of negative feed-back amplifiers apply also to any amplifying system. Nor, too, do many students really understand the effects of negative feed-back. They can produce a formula showing how much the gain or the distortion is reduced, but they do not seem to realize that all this happens because the output of the system is constrained to tend to be like the input.

But much of the applied physics syllabus is concerned with techniques. Here we want to know that the student understands the principles behind the technique, the limitations of the method, its accuracy, the circumstances in which it can be applied, and its relation to other similar techniques. He should also appreciate the significance

of the particular construction of the apparatus, understand what dimensions are critical, what materials are suitable and why. Except in so far as they help to formalize his understanding of the subject, the actual formulae from which he calculates the answer are of little importance. But he should be able to put appropriate numerical values in the formulae and get a sensible answer out. Here an understanding of dimensions is of great help in practice—but rarely seems to be used in examinations !

This then is the sort of physics which I think this part of the Graduateship examination should test. I have tried to make the questions approximate, in a simple way, to the sort of problem the student might be required to tackle in his job—in other words to make the paper seem realistic to the practical man working in the subject.

I am not very interested in whether or not the student can reproduce a particular formula. In practice, once he has decided upon the appropriate method, he can look up the formula. His value to his employer lies in his ability to decide, in the light of all the circumstances, the appropriate method to use on a particular problem. In other words he has to decide which, if any, formula to use. Even simple problems, such as the determination of the thermal conductivity of the oxide scale on a piece of steel, demand a thorough knowledge, not of methods of determining conductivity but of the conduction process itself.

I also attach some importance to the student's knowing what materials, etc., to use for his apparatus. The success or failure of even quite simple experiments can depend on this. Some knowledge of the physical properties of the simple constructional materials—steel, copper, aluminium, glass, etc., is important. Relevant properties are strength, hardness, corrosion resistance—with of course some idea of the reason for them. A knowledge of simple constructional features such as journal bearings, how and why to make copper soft and steel hard, kinematic design, etc., helps the student to appreciate just why the piece of apparatus with which he is presented looks like it does.

Then the numerical example. In the text-books—and also in most examination papers—all the numerical data required are given in the question itself so that very often the student is given a pretty good hint as to how to answer the question. In some cases this practice even tells him how to answer the first part of the question too ! Now Nature and the technical manager are rarely so kind. The student must know what formula he needs, know how to derive it or where to find it, and then know how to find the data in reference books. And here I would like to stress the usefulness of a familiarity with these to any student. Once he starts actually to do physics, he will constantly require to use them. Again, university examination papers usually give the student the data in the required units. In practice there seems

to be some law operating to ensure that all the data required for a particular problem can never be got from the same reference book. As a result familiarity with units and systems is very important and I think that students could well have more practice of this kind. I think it is absurdly unrealistic to insist that all the data you give him should always be 100 per cent in cgs or MKS units. For instance I see no objection to the use of coulombs and joules in conjunction with cgs units. It is often far more sensible than giving data in ergs or e.s.u.

I think too that the student should be encouraged occasionally to realize that, in practice, he will often have to produce an answer without exact knowledge of all the quantities, e.g. he can measure current and voltage in an X-ray tube, but will not usually know the efficiency of the tube. This is a quantity which the student of X-rays should be able to estimate reasonably well.

Also he should realize, for example, that if he is asked to calculate the capacity of, say, a smoothing condenser, there is usually no need to worry about an exact, or any other, formula. An approximate calculation from first principles is adequate as a rule since some standard condenser of about the right size will usually be used. The same principles apply in many other cases. Here the object of the calculation is to produce an adequate answer.

Most of the students taking this examination are already earning their living or have done so at some time, and I firmly believe that the more nearly the physics they are taught approaches that with which they are in daily contact, the more easily will they learn. I do not believe that the advanced student finds it too difficult to appreciate the connection between, say, electrostatic theory and the physics of the thermionic valve, or between B-H curves and transductors. I think that teachers may well find the subject more difficult themselves treated in this way—there is certainly more effort involved in preparing the material—but the student who knows quite well just what sort of problems are important in his job will, I feel sure, respond to this sort of approach.

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## REPORTS OF BRANCH AND GROUP MEETINGS

### Electronics Group: Cambridge Conference on Luminescence

This Conference was held in Cambridge on April 7–10, 1954. Most of those attending were accommodated in Emmanuel and Sidney Sussex Colleges, while the formal sessions were held in the Maxwell Theatre of the Cavendish Laboratory.

At the opening session in the afternoon of April 7, Mr. G. W. Warren, Chairman of the Group, described the origin of the

Conference, which was the first large scale one on this subject to occur in Europe since the 1938 Oxford discussion of the Faraday Society. Dr. G. F. J. Garlick took the chair, and Dr. S. T. Henderson gave the introductory lecture, after which short speeches were made by the following, who were all present at Oxford in 1938 : Dr. F. A. Kröger (Eindhoven), Dr. B. V. Thosar (Bombay), and Prof. E. Krautz (Braunschweig).

Later the same afternoon a lecture-demonstration was given by Dr. J. W. Strange on " Unsolved problems in luminescence."

On April 8, with Dr. J. W. Strange in the chair, the sessions were devoted to phosphor applications and to electroluminescence. On April 9 the papers dealt with the physical chemistry of phosphors and the nature of the luminescence centre. Mr. H. G. Jenkins and Dr. H. C. Froelich were chairmen at the two sessions. On April 10, with Dr. H. A. Klasens in the chair, more theoretical aspects of luminescence processes were considered.

The papers and discussion on them will be published as a Supplement to the British Journal of Applied Physics.

On the evening of April 9 about 80 members of the Conference and their friends attended a dinner at the University Arms Hotel, with Mr. G. W. Warren in the chair.

More than one third of those attending the Conference came from abroad, and it was particularly gratifying to meet some well-known workers in the field from Hungary. A list of the foreign visitors follows : it includes a few working in this country. The total attendance at the Conference was about 130.

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| France : | Drs. A. Bernanose, D. Curie, J. Mattler, Dr. N. Arpiarian and Mme G. Arpiarian, Dr. E. Grillot and Mme M. Bancie-Grillot, Prof. G. Destriau and Mlles B. and G. Destriau. |
| Belgium : | Prof. A. Luyckx and Mme H. Luyckx, Dr. A. J. Stokkink. |
| Holland : | Drs. T. P. J. Botden, A. Bril, G. Diemer, W. Hoogenstraaten, H. A. Klasens, F. A. Kröger, J. L. Ouweltjes, C. C. Vlam, W. L. Wanmaker, P. Zalm. |
| Germany : | Drs. P. Brauer, H. Dziergwa, E. Krautz, A. Lompe, H. Ruffler, A. Schleede, Dr. I. Broser and Frau R. Broser-Warminsky. |
| Sweden : | Dr. G. Günther and Fru G. Günther. |
| Switzerland : | Prof. J. Rossel. |
| Hungary : | Prof. A. Budò, Drs. G. Szigeti and E. Nagy. |

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| Israel : | Dr. A. Halperin. |
| India : | Dr. B. V. Thosar and V. P. Duggal. |
| U.S.A. : | Drs. K. H. Butler, H. C. Froelich, J. W. McNall, E. Meschter, J. H. Schulman, F. E. Williams, Dr. and Mrs. G. R. Fonda. |
| Canada : | Mr. F. R. Lipsett, Mr. D. R. Hamilton. S.T.H. |

**London and Home Counties Branch Summer Meeting**

On Saturday, May 29, a large party of members of the London and Home Counties Branch were the guests of Messrs. Albert E. Reed and Co. Ltd., at their Aylesford Paper Mills and Central Laboratories.

On arrival the party was welcomed by Mr. T. E. G. Baker, a Director of the Company, after which small groups were conducted round the Central Laboratories and Mills. In the Laboratories various demonstrations were given to illustrate problems connected with printing, manufacture of paper, and the testing of paper and packaging materials. In the mills, in which eleven paper-making machines are installed, Kraft wrapping paper up to 20 ft. wide is produced ; in fact, Aylesford is the only Mill in Europe able to make Kraft paper to such a width.

During the interval following lunch the Branch Chairman, Dr. J. S. Forrest, thanked the Company for allowing the Institute to visit Aylesford and for their generous hospitality. The success of the visit owes much to the efforts of two Institute members, Mr. Farebrother and Mr. F. W. Hayward, who occupy senior positions in the Aylesford organization. B.S.C.

**Yorkshire Branch Summer Meeting**

The Summer Meeting of the Yorkshire Branch of the Institute was held at the University of Hull on Saturday, May 29. After being welcomed by Professor L. S. Palmer, F.Inst.P., members visited the teaching and research laboratories. At lunch in the University Refectory, the Pro-Vice-Chancellor, Professor Brynmor Jones, and Professor Palmer, in proposing the toasts, referred to the pleasure with which they welcomed this visit, particularly as it followed so soon after the grant of the University Charter. Professor Stoner in replying expressed the thanks of the members and their ladies for the hospitality shown to them by the University.

After lunch there followed a demonstration of geophysical resistance measurements in the grounds of the University. Members and their ladies then travelled to Hornsea for tea, where they also had the pleasure of seeing the braver members of the party partly immersed in the sea. R.S.T.

**Standard Telephones and Cables Ltd. and Kolster-Brandes, Ltd.,** have the following vacancies and offer excellent personnel services, five-day week, non-contributory pensions scheme. Salaries according to age and qualifications.

**Senior valve development engineer,** aged 30–35, honours degree, required to lead group of engineers working on advanced valve development and testing. Experience of radio valve industry essential, with electronic circuitry knowledge.

**Valve application engineer,** aged 25–30, experienced in use of valves in pulse techniques, B.Sc.(Elec.) or H.N.C.(Elec.).

**Designers** of production test equipment for Radio Receiving Valves and C.R.T. Good honours degree (Elec.) or equivalent and practical experience. Excellent opportunity for first class man.

**Development chemists** for C.R.T. manufacture. One senior, one junior post, for men with first or second class honours, aged 25–35. Senior post experience of electronic industry essential, C.R.T. experience desirable. Junior post some industrial experience at least.

**C.R.T. development engineer,** man/woman aged 25–30 with good physics/maths degree or equivalent. Experience of C.R.T. work desirable.

Write in confidence stating age, qualifications and experience to the Personnel Office, Standard Telephones and Cables and Kolster-Brandes, Ltd., Footscray, Kent, quoting Ref. No. P.B.47.

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An **Engineer** or **Physicist** is required in our Research and Development Department for work on aircraft and other specialized equipment. Energy and drive essential and applicant must be capable of carrying out original ideas and be able to work on his own initiative. Degree desirable. Salary according to experience and qualifications. Please write giving full particulars to the Personnel Officer, Louis Newmark Ltd., Prefect Works, Purley Way, Croydon, quoting reference D.2.

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**City of Portsmouth College of Technology**
**Principal : W. Taylor, D.Sc., F.R.I.C.**

Applications are invited for the post of **instrument maker** in the physics department of the City of Portsmouth College of Technology. Wages will be paid at the rate of £7 per week, rising by annual increments of 5s. to a maximum of £8 10s. Applicants should have had a good general education and some practical experience of instrument repair work. Applications, giving full details together with the names of two referees, should be forwarded to the Registrar of the College not later than July 22, 1954. E. G. Barnard, Chief Education Officer.

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**The Ford Motor Company Ltd.** have a vacancy for a specialist in electronics in their automobile engineering laboratory in Birmingham. The laboratory has been newly established in connection with the design side of the organization, and the selected applicant will be responsible for the development of all matters pertaining to electronics. Previous industrial experience as well as an honours degree is most desirable. An excellent starting salary will be paid in accordance with qualifications and experience. The post is permanent and progresive and carries a generous non-contributory pension. Applications should be addressed to the Salaried Personnel Department, Ford Motor Company Ltd., Dagenham, Essex.

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**A young graduate** in physics is required to work at **Ilford Ltd.,** Watford, on the physical aspects of photographic problems, in particular those associated with the photographic effects of X-rays and Y-rays. Apply in writing to Research Director, Ilford Limited, Ilford, Essex.

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**Atomic Energy Research Establishment, Harwell, Berkshire.**

**Electrostatic High Voltage Generator Group.**

The team performing nuclear research with the 3 M.V. Electrostatic Generator of the Nuclear Physics Division requires an **Experimental Officer** to direct a small section concerned chiefly with the building and developing of particle accelerating tubes associated with the generator and assisting in the preparation of experiments. Candidates for this interesting job must be at least 27, must possess H.S.C. (science), Higher National Certificate or an equivalent qualification, and should be thoroughly familiar with ordinary workshop practice and have some knowledge of vacuum technique. Familiarity with electronics is desirable though not essential. Salary scale £690 – £850 per annum (men), £595 – £727 per annum (women). Applications, quoting 2/103/115, to the Establishment Officer, A.E.R.E. by July 23, 1954.

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A world-famous textile organization has a vacancy for a **commercial/technical representative** representing the Company at home and overseas. The job involves considerable process investigation and development work as well as the servicing of other concerns in the textile finishing side of the industry. This appointment is based on the United Kingdom with opportunities for travel abroad and also provides an excellent entry to a progressive and expanding aspect of the commercial field. Applications are invited from men of good degree standard in chemistry, physics, chemical engineering or textile technology, aged under 30 and with or without previous industrial or commercial experience. Initial salary will be at least at current market rates. Our own staff have already been considered for this appointment. Applications giving details of age, education, qualifications and experience (if any) to Box No. A.V. 62. The Institute of Physics, 47 Belgrave Square, London, S.W.1.

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**The British Iron and Steel Research Association** require at their Swansea laboratories (A) A graduate **Metallurgist** or **Physicist** with metallurgical experience to work on the development of new processes for high speed continuous coating of steel strip with non-ferrous materials. Experience in the use of X-ray or electron diffraction apparatus would be an advantage. This work is of wide interest involving problems in metallurgy, physics of surfaces, and steel strip handling plant. (B) A graduate **Physicist** or **Electrical Engineer** to work on the development of new techniques of measurement and control of coating processes and product inspection. Experience of instrument research and development including electronic techniques is desirable. The laboratories are situated adjacent to Swansea University College in Singleton Park. Commencing salary for these positions up to £740 p.a. according to age and experience. Post is superannuated under the F.S.S.U. Written applications only quoting "Swansea" to Personnel Officer, B.I.S.R.A., 11 Park Lane, London, W.1.

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